Systematic Approach To Buffer Evaluation And Regulatory Review Process

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Outline

- Background
- NRC Sponsored Testing – Lessons Learned
- Alternate Buffer Regulatory Considerations
- Next Steps

Background & Purpose

- November 16, 2006 NRC Commission Staff Requirements Memorandum directed staff to “work with industry to develop a systematic approach to buffer evaluation and encourage licensees to replace buffers, when indicated, during scheduled outages”

- Tests have shown that some buffers are more advantageous with respect to precipitate formation and impact on head loss across a debris bed. Replacement of buffers may provide a significant benefit to some plants. Since precipitate formation depends on plant specific conditions (e.g., plant materials, buffer) a systematic approach is needed

- Provide the staff expectations regarding the chemical buffer change and discuss regulatory process considerations

NRC Sponsored Head Loss Testing: Buffer Lessons Learned

Trisodium Phosphate (TSP)

- May be a good option for plants with a low dissolved calcium concentration in a post-LOCA containment pool
- For Argonne Lab test loop conditions– significant head loss was observed for TSP and dissolved calcium concentration >25 ppm (For plant evaluation purposes, test results should be scaled based on expected screen loading)

Sodium Hydroxide

- Complex interactions with large test-to-test variation, probably related to the kinetics of precipitate formation
- Large pressure drops at 100 ppm, 375 ppm dissolved aluminum, sometimes with no visible indication of precipitates
- Chemical effects characterization must account for uncertainty

NRC Sponsored Head Loss Testing: Buffer Lessons Learned

Sodium Tetraborate (STB)

- Initial tests showed no head loss at 50 ppm dissolved aluminum and significant head loss at 100 ppm dissolved aluminum
- No indication of head loss increase during follow-up long-term test with equivalent of 50 ppm dissolved aluminum in Argonne Lab vertical loop
- At pH =8.3, a measurable head loss response started at a dissolved aluminum concentration equivalent to about 70 ppm
- Long-term bench scale tests show some visible precipitate at 60 ppm dissolved aluminum
- Most favorable head loss behavior of the three existing buffers evaluated in NRC sponsored testing

Buffer Change Considerations

- A buffer chemical change may be one component in resolution of GSI-191 chemical effects
- A change to the chemical intended to buffer a post-LOCA containment pool may influence a number of areas including:
  - GSI-191 Chemical Effects
  - Accident Dose
  - Corrosion/Stress Corrosion Cracking - containment materials
  - Equipment Qualification
- The review process for buffer change amendments may be handled more efficiently by following an approved format from a lead plant

Buffer Change: Impact on Chemical Effects

NRC expectations:

- Buffer change reduces chemical effects
- Technical basis demonstrates head loss, including chemical effects considerations, is less than available pump net positive suction head
- Any chemical effects on downstream components do not compromise long term core cooling

Post Accident Dose: Issues Related To Buffer Change

- Evaluate impact of replacement buffer on assumptions for elemental iodine removal by containment spray
- If replacement buffer is sufficiently similar to current buffering capability and chemical properties, then iodine re-evolution does not need to be modeled and the current licensing basis dose analysis remains acceptable
- Replacement buffer should keep pH>7 to use Regulatory Guide 1.183 assumptions on iodine release and speciation

Corrosion / Stress Corrosion Cracking

- Changes to post-LOCA spray pH and containment pool pH can affect degradation of containment materials
- The licensee should discuss and evaluate potential degradation of piping and other components resulting from corrosion and stress corrosion cracking
- The integrity of the piping systems, structural materials and other components must be maintained

Buffer Change:
Equipment Qualification (EQ)

- Expectation - a licensee analysis that the EQ components are qualified to the new containment profile

Systematic Approach To Buffer Evaluation – Key Elements

- Thorough Containment Materials Inventory Evaluation
- Plant specific considerations (e.g., floor space, strainer debris bed characteristics)

- Testing knowledge base (NRC and industry tests) informs evaluation of buffer environment interaction with plant materials
  - Type and amount of precipitate, timing, filterability, etc.

- Analysis of post-LOCA chemical effects – head loss and downstream effects

Chemical Effects - Next Steps

- NRC needs information from industry concerning the number of PWR units planning to change buffer chemicals since this may affect how the staff reviews the license amendment requests
- Industry encouraged to identify a lead plant that would serve as a model for a buffer replacement amendment
- NRC to provide feedback on draft systematic approach to buffer evaluation developed by industry
- Propose public meeting in February 2007 to discuss details (e.g., resolution strategies, test procedures, test results) related to chemical effect evaluations
  - NRC to provide meeting expectations in January, 2007